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PATENT & TRADEMARK OFFICE

AF/2452

Practitioner's Docket No. SJO920010142US1
PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:	H. S. Gill	:	Group Art Unit: 2452
Serial No.:	10/081,046	:	Examiner: C. Magee
Filed:	02/20/02	:	
		:	

Title: **Magnetoresistance Sensor Having an Antiferromagnetic Pinning Layer With Both Surfaces Pinning Ferromagnetic Bias Layers**

APPELLANTS' BRIEF (37 CFR 1.192)

Assistant Commissioner for Patents
Washington, DC 20231

Attention: Board of Patent Appeals and Interferences

Dear Sir:

This brief is in furtherance of the Notice of Appeal for the above application, which was mailed to the U.S. Patent and Trademark Office on 09/20/04.

The fees required §1.17(f) and any required petition for extension of time for filing this brief and fees therefor are dealt with in the accompanying transmittal of appeal brief. This brief is transmitted in triplicate. (37 CFR 1.192(a))

This brief contains these items under the following headings and in the order set forth below:

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The final page of this brief bears the attorney's signature.

I. REAL PARTY IN INTEREST

The real party in interest is International Business Machines Corporation.

II. RELATED APPEALS AND INTERFERENCE

None.

III. STATUS OF CLAIMS

A. The Application was filed with 20 claims. New claims 21-23 were added in the response to the first Office Action submitted on 01/05/04. Claims 1-23 remain in the case. Claims 6 and 17 are allowed. Claims 1-5, 7-16 and 18-23 have been finally rejected.

IV. STATUS OF AMENDMENTS

All amendments have been entered by the Examiner.

V. SUMMARY OF THE INVENTION

A magnetoresistance (MR) sensor for reading information signals from a magnetic medium, the MR sensor having a structure that includes an upper antiferromagnetic layer positioned between a upper ferromagnetic layer and a free layer. The upper ferromagnetic layer provides magnetostatic bias to the sensor without a loss of exchange coupling strength between the antiferromagnetic layer and the free layer. With this arrangement of layers, both surfaces of the upper antiferromagnetic layer are employed to pin the adjacent layers, improving the efficiency of the structure.

Fig. 2 shows a portion of the MR sensor structure 50, not drawn to scale. The MR sensor structure 50 is made of a series of layers that are very thin in relation to their lateral extent. The MR sensor structure 50 has a sensor surface plane 54, a transverse direction 56 lying in the sensor surface plane 54 and perpendicular and away from the ABS 46, and a longitudinal direction 58 lying in the sensor surface plane 54 and perpendicular to the transverse direction 56. The MR sensor 52 has a free layer 60 that lies parallel to the sensor surface plane 54. At least a portion of the free layer 60 is free to respond to external magnetic fields.

An upper antiferromagnetic layer 62 overlies at least a portion of the free layer 60 and contacts that portion of the free layer on a first contact face 63. The upper antiferromagnetic layer 62 lies parallel to the sensor surface plane 54. The upper antiferromagnetic layer 62 is preferably PtMn, but it may be any operable antiferromagnetic material.

An upper ferromagnetic layer 64 lies parallel to the sensor surface plane 54. The upper ferromagnetic layer 64 overlies and contacts at least a portion of the upper antiferromagnetic layer 62 on a second contact face 66 lying parallel to the sensor surface plane 54. The upper antiferromagnetic layer 62 lies between the upper ferromagnetic layer 64 and the free layer 60.

With this arrangement, the upper antiferromagnetic layer 62 exchange couples to and pins the contacted portion of the neighboring ferromagnetic free layer 60 through the first contact face 62 and also exchange couples to and pins the contacted portion of the upper ferromagnetic layer 64 through the second contact face 66. Thus, both faces of the upper antiferromagnetic layer 62 are utilized for pinning. By contrast, in the conventional approach only the lower face of the antiferromagnetic layer 62, which contacts the adjacent ferromagnetic free layer 60, is utilized in pinning. The upper face is adjacent to a cap layer where it has no pinning function.

VI. <u>ISSUES</u>

A. Whether the Examiner has properly rejected claims 1-4, 7-15, 18, 19 and 21-23 as being anticipated by Hasegawa et al. (U.S. Pat. # 6,496,338 B2) under 35 U.S.C. 102(e).

B. Whether the Examiner has properly rejected claims 5, 16 and 20 as being unpatentable over Hasegawa et al. (U.S. Pat. # 6,496,338 B2) in view of Gill (U.S. Pat. # 6,052,263) under 35 U.S.C. 103(a).

VII. GROUPING OF THE CLAIMS

All the claims being appealed may be grouped as to the section 102(e) issues.

Claims 21-23 are considered to be separately patentable from claims 1-5, 7-16 and 18-20.

VIII. ARGUMENTS

A. The Examiner has rejected claims 1-4, 7-15, 18, 19, and 21-23 under 35 U.S.C. 102(e) as being anticipated by Hasegawa et al. (U.S. Pat. # 6,496,338 B2).

Applicant traversed this rejection on the ground that the reference does not teach every element of the claim (MPEP 2131).

First, claim 1 recites, in relevant part, the following limitation:

> "an upper antiferromagnetic layer overlying at least a portion of the free layer;"
>
> (Claim 1, line 4-5).

In contrast, Hasegawa et al. teaches "--the antiferromagnetic layers 46 are provided so that the ends thereof cover the sides of the antiferromagnetic layer 41, the pinned ferromagnetic layer 42 and the non-magnetic layer 43, and ***cover the sides of the free ferromagnetic layer 44*** to about half the thickness thereof." (Col. 11, lines 7-12 and Fig. 3)(emphasis added). Thus, the antiferromagnetic layer 46 does not overlie a portion of the free layer as claimed in Applicant's

invention, but only covers the sides of the free layer 44. It should be realized that as depicted in Fig. 3, the thickness of the free layer is greatly exaggerated relative to its in plane dimensions so that what may appear to be significant overlap of a portion of the free layer is in reality essentially zero overlap since the sides of the free layer are actually nearly vertical when drawn to scale. The antiferromagnetic layer of Hasegawa et al. fails to overlie the free layer but merely abuts the sides of the free layer.

Second, claim 1 recites, in relevant part, the following limitation:

> "an upper ferromagnetic layer overlying and contacting at least a portion of an upper antiferromagnetic layer ***on a contact face lying parallel to the sensor surface plane, so that the upper antiferromagnetic layer lies between the upper ferromagnetic layer and the free layer.***" (Claim 1, lines 6-9) (emphasis added)

Hasegawa teaches "The ferromagnetic layer 47 on the antiferromagnetic layers 46 are provided so that the ends thereof cover the ***sides*** of the free ferromagnetic layer 44 to about half of the thickness thereof." (Col. 11, lines 12-15 and Fig. 3) (emphasis added). The ferromagnetic layer 47 and the antiferromagnetic layers 46 fail to cover the free ferromagnetic layer on a contact surface that is parallel to the sensor surface plane but rather on a plane more nearly perpendicular to the sensor surface plane. The ferromagnetic layer 47 and the antiferromagnetic layers 46 merely abut the ***sides*** of the free layer so that the antiferromagnetic layer only comes between the ferromagnetic layer and the free layer over a negligible portion of the free layer on the sides that are not on a plane parallel to the sensor surface plane. Applicant submits that the

limitation to "--a contact face lying parallel to the sensor surface plane --" clearly distinguishes from the reference and is therefore not anticipated.

In his response to Applicant's arguments to this rejection of the first Office Action, the Examiner maintained that Fig. 3 of Hasegawa clearly illustrates an upper antiferromagnetic layer 46 overlying at least a portion of the free layer 44 as claimed in the present invention. Applicant respectfully points out that because Fig. 3 of Hasegawa is not drawn to scale, it is grossly misleading to rely on this figure to conclude that the upper ferromagnetic layer overlies at least a portion of the free layer. It should be recognized that the width of the free layer 44 is 2 microns (Col. 14, lines 1-4) while the thickness of the free layer 44 is 75 angstroms (Col. 13, lines 59-63). The end regions were removed by a process of photolithography and ion milling which is known to result in steep walls approaching 90 degrees to the plane of the sensor. Clearly the portion of the free layer 44 that the antiferromagnetic layer 46 can possibly overlay is less than 0.00375 of the free layer width that is calculated assuming a sidewall angle of 45 degrees. If Fig. 3 were drawn to scale, the amount of overlay represented by the sidewall of free layer 44 would be negligible. When taken with the teaching in the Hasegawa reference that "--the antiferromagnetic layers 46 are provided so that the ends thereof cover the sides of the antiferromagnetic layer 41, the pinned ferromagnetic layer 42 and the non magnetic layer 43, and ***cover the sides of the free ferromagnetic layer 44*** to about half the thickness thereof." (Col. 11, lines 7-12) (emphasis added), the Examiner's conclusion that the upper antiferromagnetic layer overlies at least a portion of the free layer is not a reasonable one. The antiferromagnetic layer of Hasegawa et al. fails to overlie the free layer and merely abuts the sides of the free layer.

In the Final Office Action and in the Advisory Action, the Examiner failed to address the limitation on "an upper ferromagnetic layer overlying and contacting at least a portion of the upper antiferromagnetic layer ***on a contact face lying parallel to the sensor surface plane*** --". Applicant submits that this limitation is not taught by the Hasegawa et al. reference and is distinct from the issue of whether the antiferromagnetic layer overlays at least a portion of the free layer as maintained by the Examiner.

In Applicant's response to the First Office Action, new claims 21-23 were added including the limitations:

> "an upper antiferromagnetic layer overlying at least a portion of the free layer ***in a plane parallel to the sensor surface plane***; and
>
> an upper ferromagnetic layer overlying and contacting at least a portion of the upper antiferromagnetic layer on a contact face lying parallel to the sensor surface plane, so that the upper antiferromagnetic layer lies between the upper ferromagnetic layer and the free layer ***in a plane parallel to the sensor surface plane***." (Claim 21, lines 4-9) (emphasis added).

Applicant believes that new claims 21-23 are patentably distinct from the Hasegawa et al. reference and are therefore in condition for allowance. In the Final Action and in the Advisory Action, the Examiner failed to address the above limitations of claims 21-23 which clearly differ from the limitations of claim 1 by the added phrases emphasized above.

Applicant considers that claims 21-23 are separately patentable from claims 1-5, 7-16 and 18-20 at issue in this appeal since even if the Examiner's rejection of claims 1-5, 7-16 and 18-20

is upheld on the grounds that the upper antiferromagnetic layer overlies the free layer as is maintained by the Examiner rather than merely abutting the steep sides of the free layer, claims 21-23 are patently distinct since Hasegawa et al. fails to teach or suggest (1) an upper antiferromagnetic layer overlying at least a portion of the free layer ***in a plane parallel to the sensor surface plane***; and (2) an upper ferromagnetic layer overlying and contacting at least a portion of the upper antiferromagnetic layer on a contact face lying parallel to the sensor surface plane, so that the upper antiferromagnetic layer lies between the upper ferromagnetic layer and the free layer ***in a plane parallel to the sensor surface plane*** as claimed in the invention.

B. The Examiner has rejected claims 5, 16 and 20 as being unpatentable over Hasegawa et al. (U.S. Pat. # 6,496,338 B2) in view of Gill (U.S. Pat. # 6,052,263) under 35 U.S.C. 103(a).

Applicant traversed this rejection on the grounds that a Prima Facie Case of Obviousness has not been established because the references fail to teach or suggest all the elements of the claims (MPEP 2143.03).

As discussed above with respect to the section 102(e) rejection, the Hasegawa reference fails to teach or suggest an upper antiferromagnetic layer overlying at least a portion of a free layer and fails to teach or suggest an antiferromagnetic layer lying between an upper ferromagnetic layer and a free layer since the reference only discloses an upper ferromagnetic layer and an upper antiferromagnetic layer that abut the ***sides*** of the free layer. The Gill reference teaches a magnetic tunnel junction sensor, but is silent with respect to an upper antiferromagnetic

layer overlying at least a portion of a free layer and an antiferromagnetic layer lying between an upper ferromagnetic layer and a free layer or a magnetoresistance sensor.

Since the combined references fail to teach or suggest all the elements of the claims, Applicant submits that the Office has failed to establish a Prima Facie Case of Obviousness.

Summary

Applicant believes that the above arguments provide a reasoned and substantive case for traversing the 35 U.S.C. 102(e) rejection of the claims. Applicant respectfully disagrees with the Examiner's position that the Hasegawa et al. reference shows an upper antiferromagnetic layer overlying at least a portion of the free layers claimed in the present invention. The Examiner appears to rely entirely on Fig. 3 of the reference which is drawn grossly out of scale and he completely ignores the Hasegawa et al. teaching that the antiferromagnetic layers are provided to cover the ***sides*** of the free ferromagnetic layer to about half its thickness. In addition, the Examiner has failed to consider the claim limitations reciting parallelism of the planes to the sensor surface plane which further distinguish the present invention from the apparent overlap at the sides of the free ferromagnetic layer of Hasegawa et al. Applicant submits that the Hasegawa et al. reference fails to teach each and every element set forth in the claims as required (MPEP 2131) and, therefor, the 102(e) rejection is not proper. A speedy allowance of all the claims is respectfully requested.

IX. APPENDIX OF CLAIMS INVOLVED IN THE APPEAL

Claim 1. (Original): A magnetoresistance sensor structure comprising:

a magnetoresistance sensor having a sensor surface plane and comprising a free layer;

an upper antiferromagnetic layer overlying at least a portion of the free layer; and

an upper ferromagnetic layer overlying and contacting at least a portion of the upper antiferromagnetic layer on a contact face lying parallel to the sensor surface plane, so that the upper antiferromagnetic layer lies between the upper ferromagnetic layer and the free layer.

Claim 2. (Original): The magnetoresistance sensor structure of claim 1, wherein the upper antiferromagnetic layer is PtMn and the upper ferromagnetic layer is CoFe.

Claim 3. (Original): The magnetoresistance sensor structure of claim 1, wherein the magnetoresistance sensor is a giant magnetoresistance sensor.

Claim 4. (Original): The magnetoresistance sensor structure of claim 1, wherein the upper antiferromagnetic layer and the upper ferromagnetic layer overlie a first portion of the free layer that is less than all of the free layer, and further including

a cap layer overlying a second portion of the free layer.

Claim 5. (Original): The magnetoresistance sensor structure of claim 1, wherein the magnetoresistance sensor is a tunnel magnetoresistance sensor.

Claim 7. (Original): A magnetoresistance sensor structure comprising:

a magnetoresistance sensor having a sensor surface plane and comprising:

a lower antiferromagnetic layer, and

a free layer overlying the lower antiferromagnetic layer;

an upper antiferromagnetic layer overlying at least a portion of the free layer; and

an upper ferromagnetic layer overlying and contacting at least a portion of the upper antiferromagnetic on a contact face lying parallel to the sensor surface plane, so that the upper antiferromagnetic layer lies between the upper ferromagnetic layer and the free layer.

Claim 8. (Previously amended): The magnetoresistance sensor structure of claim 7, wherein the lower antiferromagnetic layer and the upper antiferromagnetic layer are made of the same material.

Claim 9. (Original): The magnetoresistance sensor structure of claim 7, wherein the lower antiferromagnetic layer and the upper antiferromagnetic layer are both PtMn.

Claim 10. (Original): The magnetoresistance sensor structure of claim 7, wherein the upper ferromagnetic layer is CoFe.

Claim 11. (Original): The magnetoresistance sensor structure of claim 7, wherein the magnetoresistance sensor is a giant magnetoresistance sensor.

Claim 12. (Original): The magnetoresistance sensor structure of claim 7, wherein the upper antiferromagnetic layer and the upper ferromagnetic layer overlie a first portion of the free layer that is less than all of the free layer.

Claim 13. (Previously amended): A magnetoresistance sensor structure comprising:

a magnetoresistance sensor having a sensor surface plane and comprising:

a lower antiferromagnetic layer, and

a free layer overlying the lower antiferromagnetic layer;

an upper antiferromagnetic layer overlying a first portion of the free layer that is less than all of the free layer;

an upper ferromagnetic layer overlying a first portion of the free layer that is less than all of the free layer and contacting the upper antiferromagnetic layer on a contact face lying parallel to the sensor surface plane, so that the upper antiferromagnetic layer lies between the upper ferromagnetic layer and the free layer; and

a cap layer overlying a second portion of the free layer.

Claim 14. (Original): The magnetoresistance sensor structure of claim 7, wherein the upper antiferromagnetic layer and the upper ferromagnetic layer overlie a first portion of the free layer that is less than all of the free layer, and further including

a lead layer overlying the upper ferromagnetic layer.

Claim 15. (Original): The magnetoresistance sensor structure of claim 7, wherein the upper antiferromagnetic layer and the upper ferromagnetic layer overlie a first portion of the free layer that is less than all of the free layer, and further including

a lead layer overlying the upper ferromagnetic layer; and

a cap layer overlying a second portion of the free layer.

Claim 16. (Original): The magnetoresistance sensor structure of claim 7, wherein the magnetoresistance sensor is a tunnel magnetoresistance sensor.

Claim 18. (Original): A magnetoresistance sensor structure comprising:

a magnetoresistance sensor having a sensor surface plane, a transverse direction lying in the sensor surface plane, and a longitudinal direction lying perpendicular to the transverse direction and in the sensor surface plane, the magnetoresistance sensor comprising:

a transverse biasing stack including a lower antiferromagnetic layer, and

a free layer overlying the transverse biasing stack; and

a longitudinal biasing stack overlying the magnetoresistance sensor, the longitudinal biasing stack comprising:

an upper antiferromagnetic layer, and

an upper ferromagnetic layer overlying and contacting at least a portion of the upper antiferromagnetic layer on a contact face lying parallel to the sensor surface plane, so that the upper antiferromagnetic layer lies between the upper ferromagnetic layer and the magnetoresistance sensor.

Claim 19. (Original): The magnetoresistance sensor structure of claim 18, wherein the magnetoresistance sensor is a giant magnetoresistance sensor.

Claim 20. (Original): The magnetoresistance sensor structure of claim 18, wherein the magnetoresistance sensor is a tunnel magnetoresistance sensor.

Claim 21. (Currently amended): A magnetoresisance sensor structure comprising:

a magnetoresistance sensor having a sensor surface plane and comprising:

a free layer;

an upper antiferromagnetic layer overlying at least a portion of the free layer in a plane parallel to the sensor surface plane; and

an upper ferromagnetic layer overlying and contacting at least a portion of the upper antiferromagnetic layer on a contact face lying parallel to the sensor surface plane, so that the

upper antiferromagnetic layer lies between the upper ferromagnetic layer and the free layer in a plane parallel to the sensor surface plane.

Claim 22. (Currently amended): A magnetoresistance sensor structure comprising:

a magnetoresistance sensor having a sensor surface plane and comprising:

a lower antiferromagnetic layer;

a free layer overlying the lower antiferromagnetic layer;

an upper antiferromagnetic layer overlying at least a portion of the free layer in a plane parallel to the sensor surface plane; and

an upper ferromagnetic layer overlying and contacting at least a portion of the upper antiferromagnetic layer on a contact face lying parallel to the sensor surface plane, so that the upper antiferromagnetic layer lies between the upper ferromagnetic layer and the free layer in a plane parallel to the surface plane.

Claim 23. (Previously presented): A magnetoresistance sensor structure comprising:

a magnetoresistance sensor having a sensor surface plane, a transverse direction lying in the sensor surface plane, and a longitudinal direction lying perpendicular to the transverse direction and in the sensor surface plane, the magnetoresistance sensor comprising:

a transverse biasing stack including a lower antiferromagnetic layer;

a free layer overlying the transverse biasing stack; and

a longitudinal biasing stack overlying the magnetoresistance sensor, the longitudinal biasing stack comprising:

an upper antiferromagnetic layer; and

an upper ferromagnetic layer overlying and contacting at least a portion of the upper antiferromagnetic layer on a contact face lying parallel to the sensor surface plane, so that the upper antiferromagnetic layer lies between the upper ferromagnetic layer and the magnetoresistance sensor in a plane parallel to the sensor surface plane.

Dated:

Respectfully submitted,

By:

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Practitioner's

Docket No. SJO920010142US1
PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:

H.S. Gill	:	
Serial No.: 10/081,046	:	Group No.: 2653
Filed: 02/20/02	:	Examiner: C. Magee

For: Magnetoresistance Sensor Having An Antiferomagnetic Pinning Layer With Both Surfaces Pinning Ferromagnetic Bias Layers

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313

TRANSMITTAL OF APPEAL BRIEF
(PATENT APPLICATION-37 C.F.R. 1.192)

1. Transmitted herewith, in triplicate, is the APPEAL BRIEF in this Application, with respect to the Notice of Appeal filed on 9/20/04.

2. STATUS OF APPLICANT
This application is on behalf of
__x___other that a small entity.

3. FEE FOR FILING APPEAL BRIEF
Pursuant to 37 C.F.R. 1.17(f), the fee for filing the Appeal Brief for other than a small entity is **$340.00**.

4. EXTENSION OF TERM
The proceedings herein are for a patent application and the provisions of 37 C.F.R. 1.136 apply.

(a) Applicant petitions for an extension of time under 37 C.F.R. 1.136 for the total number of months checked below:

Extension (months)	Fee for other than small entity
____ one month	$ 110.00
____ two months	$ 430.00
____ three months	$ 980.00

_X_ Please charge my Deposit Account No. 09-0466 in the amount of $**340.00**.
A duplicate copy of this sheet is attached.

_X_ The Commissioner is hereby authorized to charge payment of the following fees associated with this communication or credit any overpayment to Deposit Account 09-0466 . A duplicate copy of this sheet is attached.

_X_ Any filing fees under 37 CFR 1.16 for the presentation of extra claims.

_X_ Any patent application processing fees under 37 CFR 1.17.

CERTIFICATE OF MAILING

I hereby certify that the above paper/fee is deposited with the United States Postal Service as first class mail in an envelope addressed to the Commissioner For Patents P.O Box 1450 Alexandria, Va 22313 on 11/19/04 .
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Signature Darci Manuleleua

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